

LARVAL TREMATODES FROM AUSTRALIAN TERRESTRIAL AND  
FRESHWATER MOLLUSCS.

PART II. CERCARIA (FURCOCERCARIA) JAENSCHI, N. Sp.

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One specimen of the pond snail, *Ameria pyramidata*, collected at Tailern Bend, River Murray, South Australia, on June 24, 1937, gave off in an aquarium numbers of ocellate forked-tailed cercariae which remained on or near the surface of the water. They were positively phototropic, crowding to that side of the glass dish nearest the light, and did not remain free swimming for long, but soon attached themselves to floating weed or to the side of the receptacle, where they remained motionless for the most part and were difficult to detach. Movement through the water might be with either head or tail foremost, and the appearance when in motion is indicated in fig. A. Decaudation took place readily.

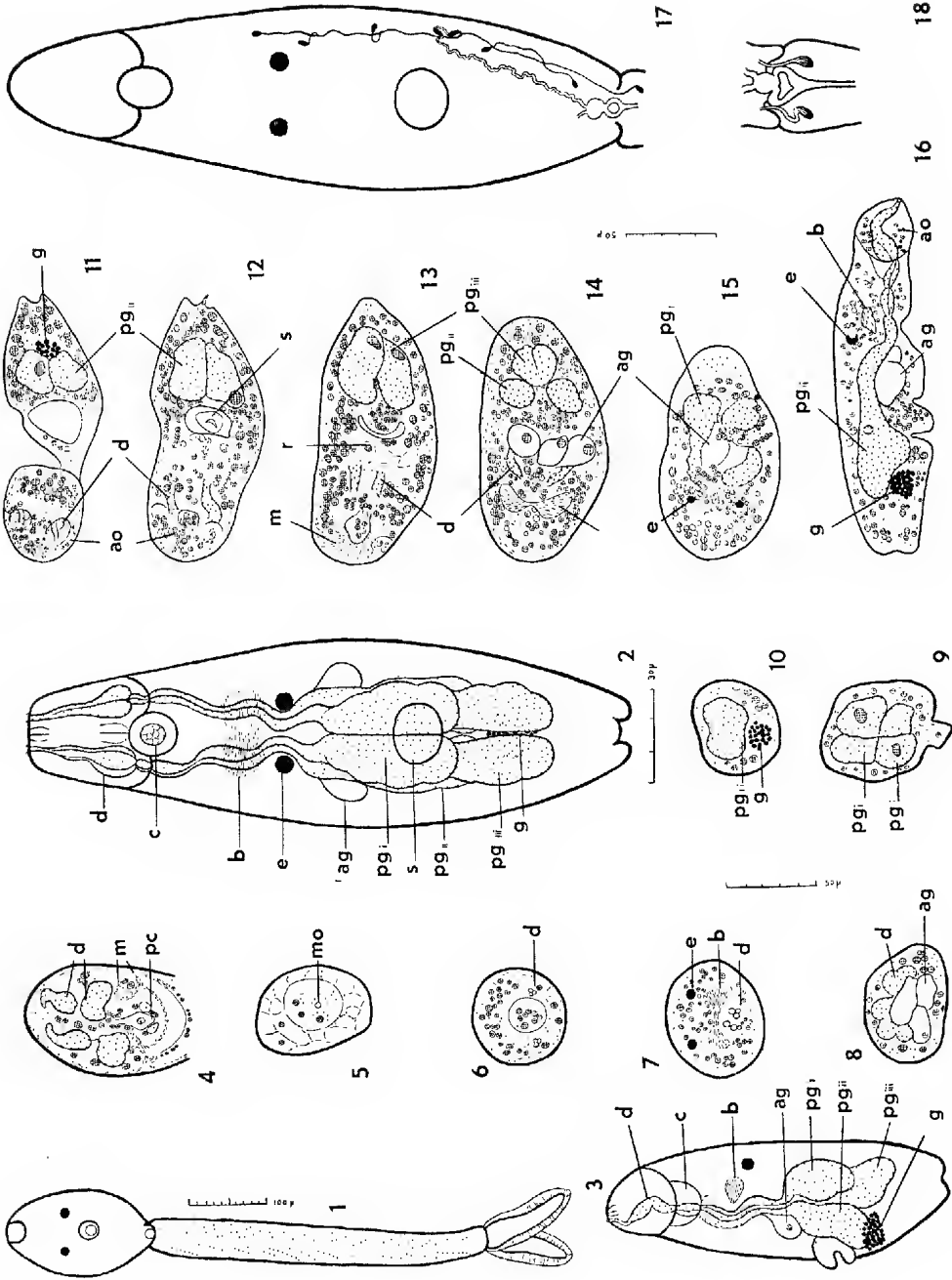
Measurements of formalinised specimens were:—length of body, 146  $\mu$ ; breadth, 77  $\mu$ ; length of tail stem, 416  $\mu$ ; breadth, 38  $\mu$ ; length of furcae, 116  $\mu$ .

The tail stem was almost three times as long as the body. Its two short furcal rami were separated from the stem by a definite constriction and each was flattened dorso-ventrally, while around the margin there was a delicate fin-membrane supported by fin rays (fig. 1). The body and tail were covered with fine spines and there was a definite ring of them around the acetabulum, those on the anterior organ being slightly larger than the remainder.

The large, well-defined anterior organ (figs. 2, 3) was 50  $\mu$  long and 35  $\mu$  broad in a body of length 200  $\mu$ , and the extreme anterior end may be retracted into a shallow pit. A mouth opening was not seen, unless it was represented by a very minute depression at the tip bounded by a few rather large cells (fig. 6). In transverse sections of the anterior organ no definite oesophagus could be distinguished, but in living and stained material a median cord of cells, perhaps the remnant of the digestive system, leading from the anterior end continued for a short distance behind the anterior organ into the body where it faded out. These cells possessed rather small, deeply-staining, nuclei, and in the posterior part of the organ a group of large pyriform cells, which were probably glandular, were contained within a distinct globular structure at the hind end of the anterior organ (figs. 4, 2). A distinct head gland was not recognised, unless represented by these cells. No trace of a definite pharynx or intestine could be seen.

A well-developed muscle layer surrounded the anterior organ laterally and posteriorly (fig. 4) and was especially marked in the swollen region where the gland ducts entered the anterior organ on either side of, and slightly ventral to, its central globular portion. The ducts expanded considerably, curved upwards, then downwards, narrowed and proceeded forwards, to open just below and on each side of the extreme anterior end (figs. 2, 3). Several minute papillae were associated with these openings and were seen best in living specimens.

The gland cells were of two kinds. An anterior coarsely granular group of two pairs situated just in front of the ventral sucker and smaller than those of the second group, were chromophobic (Miller, 1926, 34). They were arranged in a dorso-ventral and a lateral pair. The posterior, more finely granular group consisted of three pairs of very large cells staining deeply with Best's carmine.

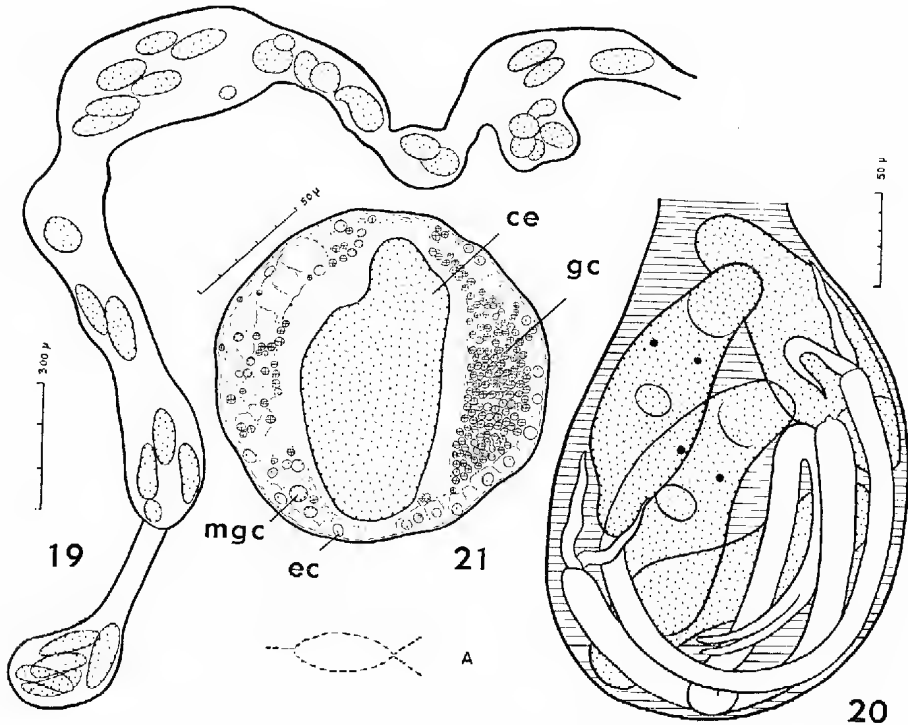


They were situated behind and above the ventral sucker and there were an anterior dorsal, a posterior dorsal, and a ventral pair. The glands were lobed, and ducts leading from them pursued a characteristic course. Commencing dorsally above, and on each side of the upper anterior gland (figs. 8, 15), they proceeded downwards and inwards at the level of the eyes, then upwards, then slightly downwards and outwards at the level of the brain, while from that point onwards they travelled in a somewhat wavy course (figs. 2, 3) to enter the anterior organ, becoming constricted while passing through the muscle layer of the latter.

The very protrusible ventral sucker,  $35\ \mu$  broad and  $28\ \mu$  long, lay in the posterior part of the second third of the body, and had a ring of fine spines.

The nervous system consisted of an H-shaped mass immediately in front of, and below, the eyes. The latter consisted each of an aggregate of dark granules, cup-shaped, surrounding a small spherical lens in the anterior part (fig. 16).

The reproductive elements consisted of a triangular mass of cells lying ventrally behind the ventral gland cells, and covered by the posterior gland cells (figs. 2, 3, 10, 16).



The excretory bladder was small, rectangular, and often difficult to see. From its anterior end arose two coiled main excretory ducts passing upwards and outwards to the level of the posterior border of the acetabulum, where each divided into an anterior and a posterior collecting tube. The anterior gave rise to three short accessory tubules, each ending in a flame cell, one just in front of the level of the eyes, the second just behind the eyes, and the third near the level of the anterior margin of the acetabulum. The posterior collecting tube passed backwards until about midway between the acetabulum and the posterior end of the body, where it gave rise to three accessory tubules, each ending in a flame cell. One of these passed forwards towards the acetabulum, the second posteriorly

until it ended just in front of the bladder, while the third terminated in a large flame cell in the base of the tail (figs. 17, 18). On a level with the acetabulum two large ciliated areas of the tubules were seen. We were unable to determine with the limited amount of living material available whether these were the dilated terminal parts of the anterior and posterior collecting tubules, or the coiled end portion of the main collecting duct which has two ciliated areas. Cort (1917) and Helen Price (1931), in their descriptions of *C. douthitti* took the latter view.

An island of Cort was present, and the main excretory duct bifurcated near the end of the tail stem to enter the furcae at whose extremities it opened.

The cercariae developed in elongate sporocysts, which were present in a tangled mass in the liver and extremely difficult to unravel. A fragment measured was 3.6 mm. long, with a maximum width of 327  $\mu$  (fig. 19).

Each sporocyst consisted of alternating narrow and expanding parts, the latter filled with germ balls and developing embryos. No very young sporocyst was seen. In the younger stages the cuticula, muscle layers, and inner epithelial cells were typical (fig. 21), but in older sporocysts these layers became thinner and were represented by little more than an enveloping cuticula and occasional flattened epithelial cells. At both ends of the sporocyst the epithelial cells were several layers deep, and were sometimes reinforced by loose cellular tissue.

All sections of cercariae, indicated in the accompanying figures, are from specimens contained in sporocysts.

*Cercaria jaenschi* belongs to the brevifurcate apharyngeate distome cercariae of Miller (1926, 65), and to group D of this classification (based upon the number of flame cells). *C. jaenschi* agrees with *C. douthitti* in having an excretory formula of  $2 \times 5 (+ 1)$ , thus separating this group from the human schistosomes on the one side, and *C. ocellata* (with one more flame cell) on the other. These groups all belong to the family Schistosomatidae. The adult of *C. douthitti* is *Schistosomatium douthitti* (Cort) Price, 1931, to which genus *C. jaenschi* probably belongs.

From *C. douthitti* (Cort, 1915; 1917), *C. jaenschi* differs in the character of the anterior organ and absence of digestive system, as well as in other minor details. The penetration gland cells are the same in number and character as, but differ in arrangement and relative size from, those of *C. douthitti* and the allied forms, *C. elvae* (Miller, 1926, 33) and *C. ocellata* (Wesenberg-Lund, 1934, 105). The unicellular glands staining with gentian violet in living cercariae, and the single pair of anterior glands found only in cercariae in the sporocyst or but recently emerged (Price, 1931, 714), have not been recognised in preserved material. They may be represented by large granular cells lying just ventral to and in front of the anterior penetration glands (fig. 13, r). Unfortunately, the snail host remained alive in the aquarium for a few days only and additional fresh material for these studies was not available.

Outbreaks of dermatitis in bathers caused by penetration into the skin of cercariae of human schistosomes in Japan, and of non-human schistosomes in Europe (Wesenberg-Lund, 1934, 136) and the United States (Cort, 1928, a, b) have been reported. In Europe *C. ocellata* causes such effects, and in America *C. elvae* and *C. douthitti* (Cort, 1928, b). As *C. jaenschi* is closely allied to the latter it will be interesting to discover whether dermatitis of this type occurs in South Australia.

Two furcocercariae have been reported from Australia: one by Cherry (1917, 4, 11) from *Bulinus ? tenuistriatus* near Melbourne, and *Cercaria greeri* by Bradley (1926) from *B. brazieri* in the Monaro district of New South Wales. The latter was also found by Ross and McKay (1929, 14) in *Limnaea brazieri*

in the latter State. From both of these species *C. jaenschi* differs in the relative proportions and characters of the body, tail stem and furcal rami.

The only adult schistosome known from Australia, apart from the two species, *Schistosoma haematobium* and *mansoni* (with which Australian soldiers became infected in Egypt), is *Austrobilharzia terrigalensis* S. Johnston (1916) from the gull, *Larus novaehollandiae*, from New South Wales.

The specific name of ?*Schistosomatium jaenschi* is given in recognition of the very generous assistance afforded us in our investigation by Mr. G. Jacnsch, of Taillem Bend.

#### REFERENCES.

- BRADLEY, B. 1926. Notes on larval trematodes from New South Wales. *Med. Jour. Austr.*, 1926, **vol. ii**, pp. 573-578.
- CHERRY, T. 1917. Bilharziosis and the danger of the disease becoming endemic in Australia. Commonwealth Defence Dept., Melbourne, 1917.
- CORT, W. W. 1915. Some North American larval trematodes. *Illinois Biol. Monogr.* 1, (4), 1915, 86 pp.
- CORT, W. W. 1917. Homologies of the excretory system of the forked-tailed cercariae. *Jour. Parasit.*, **vol. iv**, 1917, pp. 49-57.
- CORT, W. W. 1928a. Schistosome dermatitis in the United States (Michigan). *Jour. Amer. Med. Ass.*, 1928, **vol. xc**, pp. 1,027-1,029.
- CORT, W. W. 1928b. Further observations on schistosome dermatitis in the United States (Michigan). *Science*, **vol. lxxviii**, p. 388.
- JOHNSTON, S. J. 1916. On the trematodes of Australian birds. *Jour. Proc. Roy. Soc. N.S.W.*, **vol. 1**, 1916 (1917), pp. 187-261.
- MILLER, H. M. 1926. Comparative studies on furcocercous cercariae. *Illinois Biol. Monogr.* 10, (3), 1926, 112 pp.
- PRICE, H. F. 1931. Life history of *Schistosomatium douthitti* (Cort). *Amer. Jour. Hyg.*, **vol. xiii**, (3), 1931, pp. 685-727.
- ROSS, I. C., AND MCKAY, A. C., 1929. The bionomics of *Fasciola hepatica* in New South Wales, etc., C.S.I.R., Melbourne, Bull. 43, 1929, 62 pp.
- WESENBERG-LUND, C. 1934. Contributions to the development of the Trematoda Digenea. Pt. ii. *D. Kgl. Dansk Vidensk. Selsk. Skrifter, Naturv. Og. Math. Afd.*, 9. Raekke v. 3. 1934, 1-223 (pp. 104-109, 135,140).

#### EXPLANATION OF FIGURES.

All drawings were made with the aid of the camera-lucida, except fig. A and the details of figs. 17, 18. The ducts of the anterior penetration glands did not stain and could not be seen in preserved material, and so have not been drawn. Figs. drawn to scales indicated.

ag, anterior gland; ao, anterior organ; b, brain; c, central globular portion of anterior organ; ce, cercaria; d, ducts of posterior gland cells; e, eyespot; ec, epithelial cell; g, gonad; gc, germ cell; mgc, mature germ cell; ps, pear-shaped cell; pg, I, II, III, first second and third pairs of posterior gland cells; r, granular cells below anterior glands; s, ventral sucker.

Figs. 1-21, *Cercaria jaenschi*: 1, body not extended; 2, anatomy; 3, anatomy, lateral view; 4, oblique section through anterior organ; 5, Tr. Sect. extreme anterior tip; 6, Tr. Sect. posterior portion of anterior organ; 7, Tr. Sect. through region of eyes and brain; 8, Tr. Sect. showing anterior glands and ducts of posterior glands; 9, Tr. Sect. through region of acetabulum; 10, Tr. Sect. region showing genital anlage. A, appearance when in motion. 11-15, successive longitudinal horizontal sections; 16, longitudinal vertical section; 17-18, excretory system; 19, sporocyst; 20, portion of sporocyst more highly magnified; 21, Tr. Sect. sporocyst with cercaria.